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the number for the comparatively tender and delicate leaf of the white pine was found to be from 2 to 3; the number in the Scotch pine from 5 to 8. They are nearer the surface in the leaf of the white pine, fig. 8, than they are in the leaf of the Scotch pine, fig. 9, the bounding cells in the former coming in contact with the epidermal cells.

The structure seems to more closely resemble that of the passage in the cortex than of that in the wood. There is the same lining of epithelium, very thin-walled, and the surrounding thick-walled cells, one layer in the case of the leaf, the surrounding layer being thicker in the leaf of the Scotch pine than in that of the white pine. The cells lining the resin passages of cortex, wood and leaf, form resin which they afterward pour into this canal. The cells surrounding the epithelium were found to contain a large amount of starch. The walls of these surrounding cells seemed to be thicker before growth started in the spring than afterward, sections cut from the tree in February showing thicker walled cells than those cut in April or May.

Notes on Campanula Medium.

BOLLING W. BARTON.

The plant upon which observations were made does not correspond satisfactorily with figures or description of this species, but I am assured by the best authority that it is nevertheless Campanula Medium. Only a single plant was under notice, and already many of its flowers had so far passed that the determination of several details of conduct of promising interest had to be deferred.

The flowers in question are of a delicate pink or rose color. The corolla tube is about 1¼ inches in length and ¾ inch wide at the mouth, and is not spreading like those of most of the genus, but is more cylindrical, being slightly constricted about halfway down the tube. The inside of the tube is entirely destitute of hairs. Reflexed lobes from between the sepals quite conceal the ovary. The flowers are uniformly erect and not horizontal or drooping, as is characteristic of many species. This character holds good until the corolla withers, when it may incline somewhat to one side. For the rest the structure is essentially like that of other species of Campanula, the peculiarities being the expanded base of the filaments fitting over the ovary and the linear introrse anthers, which lose their pollen on the hairy style as the flower unfolds, a good example of proterandy. Attention was directed to this plant by seeing in one of its flowers a large dipterous insect vainly trying to climb up its walls. After failing in this it turned to the hairy style, up which it climbed with ease, and over the stigma and took flight. The interpretation of these movements were simple enough, if they were shown to be constant. An insect visiting the flower for the nectar in the bottom of the corolla and not being able to escape by reason of the smooth corolla, except by climbing the style and over the stigma, and the plant being proterandous, cross-fertilization becomes almost inevitable. To test the matter further, especially as regarded the slipperiness of the corolla tube, the following experiments were made: A number of insects of different shapes and species were put into the flowers and their actions carefully observed. The first one tried was a small cricket, which was handled so as not to wound it, and was dropped into the flower. It at once began to struggle to get out, but failed to make the slightest headway, its feet taking no effect whatever, so far as could be seen with a pocket-glass, upon the corolla wall. It was left in this situation but was found to have escaped some hours later—probably by climbing the style or by a well directed jump.

The next thing tried was a medium-sized bumble bee (probably Andrena), which I had knocked off a flower and slightly stunned, but which had recovered sufficiently to crawl freely and even to use its wings. The most that this bee could do towards getting out when put into the flower was to turn about and raise its head, and so standing on end, its back to the style, clawed impotently against the corolla tube until wearied out. It was then left alone for an hour, when being touched with a straw it began again its struggles, with no better success than at first. After that it was turned around so as to face the style, when it easily climbed up and escaped.

A spider was the next subject and proved itself just as unable to climb the corolla as the others preceeding. It succeeded in getting out at last by resting one of its long legs against the style and working another one over the rim of the corolla and so drawing itself to the top of the cup.

I next made use of a small grasshopper, which also entirely failed to take any hold upon the corolla wall, and after imprisonment for some minutes succeeded in making its escape by jumping out.

Finally a house-fly was caught, and having had both wings carefully clipped with scissors was dropped into the flower. The result in this case was beyond expectation of those who witnessed the experiment, notwithstanding what had gone before. The acrobatic, glass-walking fly was just as impotent in its attempts to walk up the wall of the flower as had been the other insects experimented with. In a very short time, however, the fly discovered the easy exit by the style, and after a few lessons would turn to this means of escape without loss of time. Six times in quick succession did it come up by the style and was then allowed to crawl away.

During the performance of these experiments a number of small ants were running over these same smooth walls as if they had been sanded, and also several visitors in the shape of small diptera flew in and out and crawled wherever fancy led them without difficulty. But at no time did I see one of these ants or flies ascend the style. The ants were evidently in search of nectar, and from the caravan lines which had been established in and out of some of the flowers there is little doubt but that they were getting a fair supply.

In the books are to be found the following references to the cross-fertilization of Campanula Medium. Sir John Lubbock says "Insects visiting the flower for the sake of honey do not so far as I have observed generally walk on the petals, being deterred by the stiff hairs which are scattered on their inner surface. In any case, however, they are almost sure sooner or later to clasp the style when they necessarily dust themselves with pollen." Herman Müller has nothing bearing directly upon Campanula Medium. Delpino remarks that "In the large flowers of Campanula Medium I have almost always found some species of Cetonia, which probably is the insect best adapted to fertilize this plant."

The first large insect seen in the flower was clearly unable to fly out, the space between the style and corolla wall not being sufficient to allow for the spread of the wings; still more would this difficulty hold for one of the Cetonias mentioned by Delpino. But by climbing the style and on to the stigma the place of vantage would be reached from which the wing covers could be raised and flight made easy.

As regards the visits of the ants it was noticed that very soon after fertilization of the flowers a certain relaxation of the parts followed, and the ants could then without much trouble work their way into the chamber under the expanded filaments, in which is secreted the nectar. But in the newly opened flower this chamber is effectively closed against any small insects. To test the efficiency of the roof made by these filaments against rain the experiment was made of shaving off the ovary with a razor, leaving the upper wall so as not to disturb the relations of the base of the corolla and the filaments. Then with a small, sharp blade cut out from below the remaining upper wall of the ovary, taking care to clip off the style and leave it in place to fill the angular space which would otherwise be left. Having done this nothing is left to stop the lumen of the corolla tube but these filaments. If water be now dropped into the corolla it will be found to hold perfectly.

How any considerable quantity of rain which might fall into these upright flowers could get out again remains to be found out. But it is not unlikely that it will be found that when a certain quantity of water does collect, either by its weight it will bend the flower over and escape or by its presence may excite some auxotonic movement causing the flower to nod and dump it out.

A repetition of these experiments should of course be made upon newly opened flowers and upon the particular variety here described.

Botanizing in Texas.* II.

J. REVERCHON.

In this locality (House Mts.) two entirely new plants were discovered, and both have been decorated with the name of Reverchoni, a Diplachne and a Campanula. The latter is a little annual, making long ribbons of the finest blue in the cracks of the rocks, with here and there a large tuft of Cereus pectinatus all ablaze with its beautiful pink blossoms, or a picturesque cluster of Cereus paucispinus covered with brick-red flowers. The more noted plants collected here were: on the side of the mountain, Metastelma Palmeri, Zexmenia hispida, Cyclanthera dissecta, Ipomœa Lindheimeri; on the banks of a sandy creek, Astragalus leptocaulis, and a variety of Mentzelia Wrightii with very small flowers.

From House Mt. to Mason is a region mostly sandy or rocky, in which three rare plants were collected: Panicum ciliatissimum, Brazoria truncata, and Polypteris Hookeriana. Juglans rupestris began to appear along the rocky banks of streams.

At Mason, a little German town, we resumed our westward march. The soil is generally poor, sandy or gravelly, up the Llano valley, the plain being covered with mesquit brush. At a

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*Continued from March, 1886, p. 59.